

Clean Version of Pending Claims

METHOD TO REDUCE TRANSISTOR CHANNEL LENGTH USING SDOX

Applicant: Zhongze Wang et al.
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Claims 1-48 and 54, as of August 23, 2002 (date response to first office action filed).

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(Amended) A method of reducing a channel length in a transistor, comprising:
forming a gate dielectric layer on a semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer
prevents oxide undergrowth;
forming a gate on top of the barrier layer, the gate having sides, and an effective channel
length defined by the sides and an amount of overlap between the sides of the gate and a pair of
source/drain regions; and
oxidizing the gate wherein a portion of the sides of the gate are converted to an oxide and
an effective channel length of the gate is reduced.

2. The method of claim 1, wherein coupling a barrier layer to the gate dielectric layer
comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

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3. (Amended) The method of claim 2, wherein coupling a silicon nitride (SiN) layer to the
gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN)
layer.

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(Amended) The method of claim 2, wherein coupling a silicon nitride (SiN) layer to the
gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN)
layer.

5. The method of claim 1, wherein forming a gate dielectric layer on a semiconductor
substrate comprises forming a gate oxide layer on a semiconductor substrate.

6. The method of claim 1, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

7. (Amended) A method of forming a transistor, comprising:
forming a first source/drain region and a second source/drain region in a semiconductor substrate;
forming a gate dielectric layer on the semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;
forming a gate on top of the barrier layer, the gate having sides, and an effective channel length defined by the sides; and
oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced.

8. The method of claim 7, wherein coupling a barrier layer to the gate dielectric layer comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

9. (Amended) The method of claim 8, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN) layer.

10. (Amended) The method of claim 8, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN) layer.

11. The method of claim 7, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.
12. The method of claim 7, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.
13. The method of claim 7, further including forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region.

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14. (Amended) A method of forming a transistor, comprising:
forming a first source/drain region and a second source/drain region in a semiconductor substrate;
forming a gate dielectric layer on the semiconductor substrate;
coupling a nitride layer to the gate dielectric layer, wherein the nitride layer prevents oxide undergrowth;
forming a gate on top of the nitride layer, the gate having sides, and an effective channel length defined by the sides; and
oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced.

15. The method of claim 14, wherein coupling a nitride layer to the gate dielectric layer comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

16. (Amended) The method of claim 15, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN) layer.

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17. (Amended) The method of claim 15, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN) layer.

18. The method of claim 14, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.

19. The method of claim 14, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

20. The method of claim 14, further including forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region.

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21. (Amended) A method of forming an integrated circuit, comprising:
forming a number of transistors on a semiconductor substrate, wherein
forming at least one of the number of transistors comprises:

forming a first source/drain region and a second source/drain region in the semiconductor substrate;
forming a gate dielectric layer on the semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;
forming a gate on top of the barrier layer, the gate having sides, and an effective

channel length defined by the sides;

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oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced; and

electrically connecting the number of transistors.

22. The method of claim 21, wherein coupling a barrier layer to the gate dielectric layer comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

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23. (Amended) The method of claim 22, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN) layer.
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24. (Amended) The method of claim 22, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN) layer.

25. The method of claim 21, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.

26. The method of claim 21, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

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27. (Amended) A method of forming an integrated circuit, comprising:
forming a number of transistors on a semiconductor substrate, wherein forming at least one of the number of transistors comprises:
forming a first source/drain region and a second source/drain region in the

semiconductor substrate;

forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region;

forming a gate dielectric layer on the semiconductor substrate;

coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;

forming a gate on top of the barrier layer, the gate having sides, and an effective channel length defined by the sides;

oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced; and

electrically connecting the number of transistors.

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28. (Amended) A method of forming an integrated circuit, comprising:

forming a number of transistors on a semiconductor substrate, wherein forming at least one of the number of transistors comprises:

forming a first source/drain region and a second source/drain region in the semiconductor substrate;

forming a gate dielectric layer on the semiconductor substrate;

coupling a nitride layer to the gate dielectric layer, wherein the nitride layer prevents oxide undergrowth;

forming a gate on top of the nitride layer, the gate having sides, and an effective channel length defined by the sides;

oxidizing the gate after all source/drain regions have been formed, wherein a

Claim 29
portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced; and
electrically connecting the number of transistors.

29. The method of claim 28, wherein coupling a nitride layer to the gate dielectric layer comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

Claim 30
30. (Amended) The method of claim 29, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN) layer.

Claim 31
31. (Amended) The method of claim 29, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN) layer.

32. The method of claim 28, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.

33. The method of claim 28, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

34. The method of claim 28, further including forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region.

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35. (Amended) A method of forming a memory device, comprising:
forming a number of transistors on a semiconductor substrate, comprising:
forming a first source/drain region and a second source drain region in the
semiconductor substrate;
forming a gate dielectric layer on the semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer
prevents oxide undergrowth;
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forming a gate on top of the barrier layer, the gate having sides, and an effective
channel length defined by the sides;
oxidizing the gate after all source/drain regions have been formed, wherein a
portion of the sides of the gate are converted to an oxide and an effective channel length of the
gate is reduced;
forming a number of wordlines coupled to the gates of the number of transistors; and
forming a number of bitlines coupled to the first source/drain region of the
number of transistors.

36. The method of claim 35, wherein coupling a barrier layer to the gate dielectric layer
comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

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37. (Amended) The method of claim 36, wherein coupling a silicon nitride (SiN) layer to the
gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN)
layer.

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38. (Amended) The method of claim 36, wherein coupling a silicon nitride (SiN) layer to the
gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN)
layer.

39. The method of claim 35, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.

40. The method of claim 35, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

41. (Amended) A method of forming a memory device, comprising:
forming a number of transistors on a semiconductor substrate, comprising:
forming a first source/drain region and a second source drain region in the semiconductor substrate;
forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region;
forming a gate dielectric layer on the semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;
forming a gate on top of the barrier layer, the gate having sides, and an effective channel length defined by the sides;
oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced;
forming a number of wordlines coupled to the gates of the number of transistors; and
forming a number of bitlines coupled to the first source/drain region of the number of transistors.

42. (Amended) A method of making an information handling system, comprising:
providing a processor chip;
forming a semiconductor memory device, comprising:

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forming a number of transistors on a semiconductor substrate, comprising:

forming a first source/drain/region and a second source/drain region in the semiconductor substrate;

forming a gate dielectric layer on the semiconductor substrate;

coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;

forming a gate on top of the barrier layer, the gate having sides, and an effective channel length defined by the sides;

oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced;

forming a number of wordlines coupled to the gates of the number of transistors;

forming a number of bitlines coupled to the first source/drain region of the number of transistors; and

coupling the processor chip to the semiconductor memory device with a system bus.

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43. The method of claim 42, wherein coupling a barrier layer to the gate dielectric layer comprises coupling a silicon nitride (SiN) layer to the gate dielectric layer.

44. (Amended) The method of claim 43, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises remote plasma nitride processing to form a silicon nitride (SiN) layer.

45. (Amended) The method of claim 43, wherein coupling a silicon nitride (SiN) layer to the gate dielectric layer comprises composite oxidation processing to form a silicon nitride (SiN) layer.

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46. The method of claim 42, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate oxide layer on a semiconductor substrate.

47. The method of claim 42, wherein forming a gate dielectric layer on a semiconductor substrate comprises forming a gate dielectric layer on a silicon substrate.

48. The method of claim 42, further including forming a first source/drain extension adjacent the first source/drain region and a second source/drain extension adjacent the second source/drain region.

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54. (Amended) A transistor formed by the following process:
forming a first source/drain region and a second source/drain region in a semiconductor substrate;
forming a gate dielectric layer on the semiconductor substrate;
coupling a barrier layer to the gate dielectric layer, wherein the barrier layer prevents oxide undergrowth;
forming a gate on top of the barrier layer, the gate having sides, and an effective channel length defined by the sides; and
oxidizing the gate after all source/drain regions have been formed, wherein a portion of the sides of the gate are converted to an oxide and an effective channel length of the gate is reduced.
